DEVELOPING A STATE COGENERATION PROGRAM

R. Gordon Bloomquist, Ph.D.
Washington State University Energy Program

Abstract
Nationwide, over 2,000 state institutional facilities rely on district heating and cooling to meet their thermal energy requirements. Many of these facilities would make ideal hosts for the development of cogeneration. However, because of a lack of 1) information about cogeneration, 2) facility personnel with cogeneration experience, 3) state incentives, 4)technical assistance, 5) financing, and 6) legislative authority, many development opportunities are lost.

A potential solution to the problem is the development of a comprehensive state cogeneration program specifically aimed at pursuing cogeneration development opportunities at state institutions.

Key Words
Cogeneration, institutional facilities, legislation, financing, contracting authority

The Problem

Nationally, large state institutional buildings consume large amounts of electricity and fossil fuels to support daily operations. The electricity they consume is produced, for the most part, at relatively inefficient (30 - 40 percent efficient) central generating plants by burning coal, fuel oil, and natural gas. Production of electricity accounts for almost half of all domestic emissions of carbon dioxide (CO_2), more than half of all oxides of nitrogen (NO_x) emissions, and more than half of all sulfur dioxide (SO_x) emissions.

Many areas of the country are facing if not major shortfalls in electrical generating capacity, major changes in pricing and/or constraints on transmission capacity, all directly or indirectly opening the door for expanded opportunities for cogeneration/self-generation. However, environmental concerns, including emissions of the aforementioned air pollutants, as well as water use and water pollution, make the siting of new projects increasingly difficult. Efforts to site new transmission lines face strong opposition and in many areas, utilities are unwilling or unable to make major investments in transmission upgrades. These concerns may result in an eventual crisis if new generating facilities cannot be developed to meet growing urban loads.

At the same time, experience from numerous state institutions indicates that boilers operated to meet site thermal requirements frequently suffer from oversizing and insufficient maintenance, routinely leading to efficiencies for energy delivered to load below 60 percent. Aging steam or hot water distribution and condensate return systems compound the problem and reduce efficiencies even further. The combination of these problems results in excess fuel consumption, ever increasing costs, and large quantities of air pollutants being exhausted into the atmosphere.

Fortunately, there is a potential solution to these twin problems of meeting the increasing demand for electricity and reducing the pollution from thermal energy production. In the private sector, particularly at industrial sites, *cogeneration* is increasingly becoming accepted as the preferred source of generation. Many cogeneration plants operate at a combined (electric and thermal) efficiency higher than 80 percent. Thus, cogeneration can improve fuel use efficiency, significantly reduce the release of air pollutants, be developed in small or medium increments to serve specific loads, and fit within existing, urban sites where the power is most needed. The need for expensive and controversial line upgrades or peaking projects can often be obviated. The key to efficient cogeneration is a large, stable, and constant thermal load which can be met with the thermal energy that is produced as a by-product of electrical generation.

A large, untapped resource capable of sustaining several thousand megawatts of cogeneration development exists at the hundreds of district heating and cooling (DHC) systems currently operating in the U.S. at state institutional facilities. Nationwide, over 2,000 sites feature heating and cooling plants consisting of large, central boilers serving facilities via extensive distribution systems. Such facilities include colleges and universities, state hospitals, correctional facilities and state capitol campuses. These district heating and cooling (DHC) systems represent a significant potential for cost-effective and environmentally preferable cogeneration development. This thermal load could easily support the installation of several thousand megawatts of cogeneration to meet increases in the demand for electricity while achieving a high fuel use efficiency and a subsequent reduction in air emissions. Development of cogeneration at these facilities could additionally spur DHC development to service thermal loads adjacent to these facilities. If a majority of the projects are based on natural gas, renewable resources, or clean coal technologies there could be a significant reduction in CO_2, SO_x, and NO_x emissions in contrast to oil, natural gas, and coal-fired boiler systems now in operation.

Since much of the infrastructure is already in place, cogeneration development at these sites may be much more cost-effective and more readily developable than at facilities without such an infrastructure. Yet, traditionally, cogeneration developers have overlooked examining the feasibility of developing at sites where existing district heating systems exist.

In general, the economic feasibility of cogeneration development depends largely on the value of the electricity produced or displaced by the cogeneration plant. At present, however, there is little information available to institutions possessing district heating systems that provide them with a systematic approach to determining the economic feasibility of their systems, as well as determining the additional societal benefits available through lower direct costs and reduced pollution levels. And most recently institutions are faced with the complexities of a deregulated electric utility system.

The cogeneration potential at state institutions with existing DHC systems is poorly documented and understood by those operating such systems. Cogeneration is a complex subject for analysis and study and one that is often beyond the technical understanding of site personnel. The intricacies of project feasibility assessment, ownership considerations, permitting, financing, fuels procurement, power marketing, and risk avoidance often deter the development of good potential

projects. As a result, many development opportunities are lost, particularly at the time of boiler plant upgrades or utility infrastructure renewal when project development would be most attractive.

A number of institutional obstacles to cogeneration development also exist. In fact, many states do not provide the authorities necessary for state institutions to become involved in cogeneration development.

The Solution

The solution being adopted and implemented in more and more states is the establishment of a strong, comprehensive state cogeneration program aimed at developing cogeneration projects at state institutions having district heating and/or cooling systems. Examples of states with cogeneration programs include California, Connecticut, Florida, Iowa, Massachusetts, Michigan, Nebraska, New Jersey, New York, Rhode Island, Texas, Utah, and Washington. Some of the states have very well thought out programs and are aggressively developing cogeneration projects, e.g., California, while others are programs in name only. The California program was established in 1981, and under the leadership of the Office of Energy Assessment (OEA) participated in the development of several hundred MWe of cogeneration powerplants. OEA's program extended beyond cogeneration development to also encompass energy conservation, infrastructure improvements, and the intervening into utility commission proceeding to promote fairness in rates. The California program, when approved by Governor Brown, had as its goal a 20 percent reduction in energy use; the development of 400 MW of cogenerated electricity, which was expected to save 8.8 billion cubic feet of natural gas or 1.5 million barrels of oil annually; and the production of 2.4 billion kWh of electricity—enough to supply 1 million new homes. Because of its long and successful history, it served as the model for Washington State's program.

Washington became interested in new generation, and specifically cogeneration, much later than did California. Washington and the entire northwest, unlike California and much of the rest of the United States, was blessed with a surplus of low-cost hydro-based generation throughout the 1980s. Not only did we not need new generation, we terminated work on four 1,000 MW nuclear facilities early in the 1980s. However, by 1988, forecasts of surplus turned to predictions of shortfall, and by the early 1990s, the door was wide open for cogeneration development.

In the early 1990s, Washington's institutional cogeneration program was initiated with the goal of developing cogeneration at the state's major institutions. As was the case in California, it was conceived as part of a larger program designed to promote conservation at all state facilities, including school districts. The cogeneration program had three main objectives:

1. The establishment of a legislative framework that would allow the Washington State Energy Office (WSEO), now the Washington State University Energy Program (WSUEP), and state institutions to aggressively pursue and develop cogeneration projects;
2. the authorization of a broad array of financing options for use in cogeneration project development; and

3. the development of comprehensive technical service capability in the areas of engineering, economic analysis, and financing.

The first task was to establish the authorizing environment. Being late to enter the field, Washington had the distinct advantage of being able to learn from the successes and failures of those who had gone before. After careful analysis of the history of other states' cogeneration programs, the following list of needed legislative elements was developed:

1. Incentives for host facilities to undertake the substantial efforts, incur the cost of evaluating, and bear the risks of implementing cost-effective cogeneration projects;
2. flexible financing authority to ensure that a variety of financing options are available to state institutions that choose the self-build option;
3. the provision of secure and accessible program funding to ensure program and project continuity over the multi-year period typically required to identify and implement cogeneration projects;
4. contracting and leasing authority to permit state agencies to enter into long-term contracts for fuel, thermal energy, and/or electricity, to permit state agencies to contract with third parties for development services, and to provide long-term leases of facility property to third parties for plant construction and operation; and
5. authority to support committed agency action, established with clearly defined agency authority and responsibility to engage in cogeneration development to ensure confident agency and facility participation.

It is important to look closely at each legislative element so as to better establish the importance of each to the success of a viable state cogeneration program.

Benefit-Sharing Between Host Sites and State Government

Although cogeneration development at state facility sites often yields substantial benefits to the site and the state, the potential benefits are not free to the host site or, for that matter, the state, but require significant commitments of time and money to achieve. The full cooperation and commitment of the host site is critical to project success. Facility staff must spend considerable amounts of time in the identification and evaluation of potential project opportunities. They must be willing to commit a great deal more time to actually implementing projects once they are identified. There will also be substantial out-of-pocket expenses related to data collection, engineering services, economic analysis, legal and financial counsel, travel, communication, etc. Many of the costs will be incurred even before viable projects are identified with the risk that no developable project will be identified or that unforeseen circumstances will keep viable projects from being built.

Experience in Washington confirms what many states have learned before—that neither state-level agencies expected to administer such programs, nor host facilities expected to implement them, are likely to commit the resources needed to pursue viable projects without a strong assurance that they can capture at least a portion of the benefits such projects yield.

To encourage agencies and host facilities to pursue cogeneration and other energy efficiency projects, legislation enacted in 1991 provided for the retention by state agencies of 100 percent of net savings resulting from reduced energy costs and 50 percent of all net revenue generated by energy efficiency and cogeneration projects. The legislature further directed that each state agency's share of net savings and all net revenue be used in priority order to fund ongoing operation, maintenance, and improvements in energy systems and energy efficiency measures, to other ongoing and deferred maintenance, and to infrastructure improvements. Unfortunately, facility fiscal officers are not above temptation and when times are tight, find ways around the best intentions of legislation.

While some agencies' staff felt that they should be entitled to 100 percent of all revenue, the legislation appears to be providing the desired outcome.

Project Financing Mechanisms

Energy and cogeneration projects must compete for capital funding with core academic programs at state and regional universities and community colleges, with critical security requirements at state prisons, and with basic health care imperatives at state hospitals. Unfortunately, capital expenditures on energy projects can seldom win a head to head competition for capital funding. At the same time, ever increasing operating budgets tend to be viewed as a necessary evil in the role of supporting rather than competing with core facility functions.

Because of this, alternative financing mechanisms must be made available if cogeneration projects are to go forward. State agencies and host facilities must have the expressed legislative authority to use capital budget funds for state facility energy projects; to issue revenue bonds and enter into financing contracts or other instruments secured by project savings or revenue; to use private third party financing wherever it can provide benefits to the state; and to enter into financing arrangements with other agencies as appropriate. State agencies and host facilities must have the flexibility to size, structure, and finance projects in different ways depending on needs.

Capital Budget Funding

Capital budget funding has inherent problems even when accessible by an agency or host facility for energy projects. The capital budget process is very cumbersome, and in most cases, ill-suited for developing many kinds of energy projects in rapidly changing and increasingly competitive energy markets. Separate budget requests and approvals are normally required at each stage of project planning, design, and construction, slowing down the process and increasing delays and uncertainties that can derail even the best projects. On the other hand, capital budget funding is normally guaranteed through the sale of general obligation bonds that can provide, with certain limitations, the lowest cost of capital.

State-issued Revenue Bonds

State-issued revenue bonds, on the other hand, would be secured by revenues provided by energy projects. The revenue might come from the sale of cogenerated power to utilities, or of thermal energy to users near the state's host facility through an expansion of the facilities' DHC system, or to a DHC company.

State-issued revenue bonds can offer important advantages. Since the loans they represent are repaid through projects revenues, they leave state capital outlay and operating budgets available for competing state priorities. Projects eligible under federal tax laws could also benefit from the lower cost of debt from tax-exempt borrowing.

Third Party Financing

Third party financing, **s**timulated by project revenue potential, is another important source for financing energy projects at host facilities. Third party projects (including second party utility projects) are privately developed, owned, and financed. They could be located at state facility sites under long-term leases with the facility, and sell electric and/or thermal energy to the site under long-term contracts providing cost savings or revenue to the site. Depending on the scale of the project, they might alternately sell all of the electricity to a utility and the thermal energy to the site or to nearby users.

Potential advantages to the state or host facility from third party development include shifting project costs and risks to private parties plus utilizing their experience and expertise in energy project development. The cost to the state of obtaining these advantages will usually be a smaller share of project benefits than the facility could realize if it were to develop, finance, and own the project itself.

One very important aspect of third party development is the procedure for securing services. State competitive bidding statutes usually require award to the lowest bidder or, in this case, the highest bidder regardless of qualifications.

To avoid procurement pitfalls, the legislature granted express authority to enter into contracts through **competitive negotiation** for the development, ownership, and/or operation of a cogeneration facility. In determining an acceptable bid, the state agency or host facility may consider such factors as technical knowledge, experience, management, staff, or schedule, as may be necessary to achieve economical construction and operation of the project.

Program Funding and Reimbursement

The undeniable fact is that development costs money—large sums of money to identify, evaluate, and implement energy efficiency and cogeneration projects. One recent project in Washington State, required 19,000 person hours to reach ground breaking, and 53,000 person hours before the project was deemed fully operational. Costs include state agencies staff assigned to the program, facility staff assigned to individual projects, and consulting services to assist state and facility staff in project identification and development.

Sources and mechanism through which these costs can be paid include:

1. agency and institutional budgets funded through the state's ordinary budget process;
2. interagency agreements between the state energy office and other agencies or individual host sites;
3. proceeds from energy efficiency/cogeneration revenue bonds discussed above;

4. reimbursements from successful third party developers;
5. an energy efficiency fund or similar dedicated account earmarked for project development purposes;
6. grants and loans from federal, state, and local agencies and institutions;
7. grants loans, rebates, or other incentives from electrical or natural gas utilities; and
8. various combinations of the above.

It is vital that state agencies and host facilities have clear legislative authority to receive and use any and all of these funding sources to cover the costs incurred in identifying, evaluating, and implementing cogeneration projects. It is especially important that reimbursement of costs from successful third party developers be authorized as one of the benefits to the state. Amounts may be mandated or negotiated on a project-by-project basis.

The California OEA had originally set the reimbursement fee at $500,000 per project, payable at project closing but claims that costs incurred have been significantly higher.

Procurement, Leasing, and Contracting Authority

Once state and public facilities have identified promising energy efficiency and cogeneration opportunities, they can be developed either as publicly-owned projects or through private third parties which would develop, own, and possibly operate the plants on state facility sites.

Cogeneration projects often require several years for development, and once on-line should operate for 15-20 years or more. Because of this, it is necessary that all legal and contractual arrangements associated with such projects be able to extend over the life of the project and not be limited by the legislative biennium as might otherwise be the case.

Depending on the type of project, the following leasing and/or contracting issues must be considered:

1. ground leases of real property by the state or host facility to a third party developer/owner of a cogeneration plant located at the host facility;
2. contracts for state purchases of electricity and thermal outputs (steam, hot water, chilled water) from third party-owned cogeneration plants for use at the host facility;
3. performance-based or shared savings contracts between state facilities and energy service companies or third party cogeneration developers who provide site benefits in the form of savings;
4. contracts to purchase fuels such as coal, natural gas, oil, or biomass for state or host facility-owned cogeneration plants;
5. contracts to sell electricity produced by state or host facility-owned cogeneration plants to utilities;
6. contracts to sell steam, hot water, or chilled water produced by state or host facility-owned cogeneration plants to other users located near the host facility site; and/or

7. contracts for third party operations and maintenance services for state or host facility-owned cogeneration plants or contracts for host facility operation and maintenance of a third party project located at a host facility.

Again, it is critical that state agencies and host facilities be provided with the ability to procure services not on the basis of low bidder, but based on non-price factors such as technical knowledge, experience, management, staff, etc.

Ideally, leasing and contracting authority should provide for entering into agreements of at least 20 years with clauses that provide for extension and/or renegotiation with the original contractor or leasor at the end of the primary terms.

Washington State University Energy Program Authority

Because most state agencies and host facilities do not have experienced energy personnel on staff, and because of the highly technical nature of cogeneration development, it is extremely important to have the authority and responsibility for cogeneration development concentrated in one agency. In California, as was mentioned earlier, it was the Office of Energy Assessments which is part of the Department of General Services. In Washington, it is the WSUEP. In Massachusetts, it was the Executive Office of Energy Resources, now the Department of Energy Resources.

Whichever state agency is given responsibility for cogeneration development, it must have legislatively explicit duties, authorization, and responsibilities relating to identifying, evaluating, and developing energy efficiency and cogeneration opportunities at state facilities. One reason that OEA had succeeded is it has clear authority, responsibility, and accountability for the program's success, and OEA had sought and been given the legal, financial, and technical resources needed to do the job. Although OEA relied primarily on outside consultants in the early years of the program, it soon developed its own in-house expertise and a staff competent to take over most of the analytical functions previously performed by others. Although OEA still relied on consultants for highly technical engineering, financing, and legal matters, it provided the strong, centralized policy and program direction that any successful program must have.

In Washington State, the legislature gave WSUEP the responsibility for identifying priorities for cogeneration at state facilities, conducting feasibility studies, and the authority to approve contracts for energy sale or purchase. WSUEP also has the authority to contract for the sale of electricity and thermal energy. In addition, all state agencies and host facilities must consult with WSUEP before any agreements are reached relating to acquiring, installing, permitting, constructing, owning, operating, and maintaining cogeneration equipment; leasing state property; contracting to purchase electricity, thermal energy, or fuel; and entering into agreements for third party cogeneration development.

Establishing the legislative framework, including a broad array of financing options is, however, only the first hurdle to the establishment of a successful state cogeneration program. Equally or possibly even more important is how the responsible state agency works with other state agencies and host facilities, utilities, third party developers, financiers, contractors, vendors, and operation and maintenance providers.

The state agency has first to gain the trust and respect of the other state agencies and host facility staff. No one will willingly give up or share responsibility or authority unless value is provided. The perception of value depends almost entirely upon the establishment of credibility and technical expertise in engineering and economic analysis, financing, contracting, and project management.

The WSUEP can provide comprehensive technical services either by hiring and training staff, by hiring consultants, or through a combination of both.

As was mentioned above, the California OEA initially depended upon outside consultants for a majority of the work. Once staff was brought up to speed, much of the routine work as well as policy direction was provided internally while consultants were relied upon to cover peaks in work load or when specialized expertise is not available in-house; i.e., in the areas of fuel procurement and utility or third party contract negotiations.

Credibility is not, however, established through technical competence alone. Equally important is the establishment of an understanding and respect for the institution and the institution staff's goals, perceived mandates, relationships to servicing utilities, and physical plant operational philosophies and constraints. Finally, credibility is established through consistency—consistency of staff assigned to a project, consistency of consultants working with a facility, and consistency of advice.

Energy Program staff and consultants, however, can only do so much and can do almost nothing without full and enthusiastic support of the host facility. As with the development of a community district heating and/or cooling system, the real key to success is having a champion or superman inside the host facility. The individual must have a good understanding of the host facility's existing system, enjoy the respect of the physical plant staff, be a leader, an innovator, and have a high degree of credibility with the facility administration, and have decision-making powers.

Finally, WSUEP management must be fully committed to ensuring the success of the cogeneration program and be willing to play a major role and, when it becomes necessary, to do so enthusiastically.

Conclusion

Cogeneration development is complex, expensive, and time consuming. A successful state cogeneration program requires a solid legislative framework upon which the program can be built, an agency with the responsibility and authority to aggressively pursue cogeneration opportunities, a dedicated and technically competent staff supported by a strong consulting team, committed management, and finally adequate funding to carry projects through the development process.

End Notes

In developing this paper, the author relied heavily upon information found in the following publications:

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